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Water Conditions of the Habitat of the Water Spider *Argyroneta aquatica* (Araneae: Argyronetidae) in Mizoro Pond

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桝元敏也・桝元智子・吉田　真・西川喜朗：深泥池におけるミズグモの生息場所の水質条件

Abstract The water spider, *Argyroneta aquatica*, is the only spider that lives under water. In Japan, due to the fragmentation and the deterioration of the habitat, a policy for conservation of this spider is needed without delay. However, there is no information about the water condition of the habitat of this species. As a study of the conservation of the water spider, we conducted field surveys on the measurement of temperature, pH, and DO (Dissolved Oxygen) of the water in Mizoro pond, which is a habitat of the water spider, in May 1996. The water in which the water spider lived had lower pH and DO than the water in which the water spider did not live. It appears that this low DO value does not allow fishes to live. Consequently, the low DO would prevent potential predators, such as fishes, to live in the habitat of the water spider, giving an enemy free space to them. This low pH and DO is thought to be kept by the activity of sphagna, which is important for habitat conservation of the water spider in Mizoro pond.

Introduction

The water spider, *Argyroneta aquatica* Clerck, is the only spider that can walk and swim under water (Bristowe 1958, Foelix 1981). In Japan, the water spider has been found in the followings; Mizoro pond in Kyoto Prefecture (Yaginuma 1977, Yaginuma *et al.* 1981), Kiritappu, Kusiro swamp, Teshio, Sarobetu swamp in Hokkaido prefecture, Syariki village in Aomori prefecture, Oita prefecture, Kagoshima prefecture (Nishikawa *et al.* 1977, Katsura 1981, 1982), Kushiro in Hokkaido prefecture (Matsuda 1996). These habitats are isolated geographically.

Furthermore, Katsura & Nishikawa (1982) reported that the water spider was collected at only three out of one hundred of ponds and wetlands in Aomori prefecture. So, the habitats of the water spider seem to be limited. What is worse, the dispersal ability of the water spider is thought to be lower than other spiders, because the water spider lacks ballooning behavior (Masumoto *et al.* 1998). Consequently, when populations become fragmented and the number of individual decreases by the deterioration of habitat condition, the water spider in Japan may have a high risk of extinction. Furthermore, the water spider has been registered as an endangered species in Red Data

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list in Japan since 1995.

For the conservation of the water spider in Japan, research in the habitat conditions of the spider is needed. Though there is much information about ecology and behavior of the water spider under rearing condition (Crome 1951, Nishikawa & Yaginuma 1977, Kayashima 1991, Masumoto *et al.* 1998), there has been no reports about water conditions in the field. This paper is the first study examining temperature, pH, and dissolved oxygen (abbreviate DO), in the habitat of the water spider.

Methods

Collection site

Investigations were conducted at Mizoro pond situated in the north of Kyoto basin in Japan, and the area of the pond was about 9 ha. A floating island composed of *Sphagnum palustre* and *S. cuspidatum* occupied the center and about one third of the pond. In "Hummock", a slightly elevated hill on the floating island, the vegetation was composed of several species of trees, such as *Pinus densiflora, Rhus trichocarpa, Vaccinium oldhamii, Ilex crenata.* There were many herbaceous plants on "Hollow", which was sometimes under water shallowly. The water spider had been collected from the floating island so far (Yoshida 1994).

Measurement of water conditions

We tried to capture water spiders with a water net at 5 sites in the Mizoro pond on 1 May 1996 and measured pH with YOKOGAWA pH meter MODEL PH82, DO in water and the water temperature with DKK DO meter, MODEL HDO-110. Sites 1 and 2 were on hollow, sites 4 & 5 were the periphery of hummock. Site 3 was the periphery of Mizoro pond. The measurements were conducted for five times at each collection site 20 cm below the water surface at between 13 : 00 and 15 : 00.

Results

We captured the water spiders at sites 1 and 2, which were on hollow, but did not at sites 3, 4, and 5. The pH, DO and temperature of water were significantly lower in the water where the water spider was captured than those where it was not captured (nested-ANOVA, Tables 1 and 2). However, the difference of the water temperature between them was small (Table 1).

Discussion

There has been no research on the water conditions of the habitat of the water spider, and this report is the first study examining water of the habitat of this spider. In this research, we obtained an interesting result: the water spiders were captured from the low DO and the low pH water in Mizoro pond. Though our investigation did not conduct throughout a year, Kadono (1981) reported the seasonal changes of water conditions, such as DO, pH, and temperature, in several points of Mizoro pond. In his results, DO and pH of the sites 1 and 2 of our collecting points, where we captured water spiders, were shown to be lower than other sites throughout a year.

In general, fishes, possible predators of the water spider, were not able to live in the

Table 1. Water conditions (Mean±SE. n=5 for each site) in Mizoro pond on May 1, 1996. Asterisks show the sites where the water spiders were captured.

site	Temperature (°C)	pH	DO (mg/l)
1*	18.2±0.3	4.48±0.02	0.32±0.05
2*	17.2±0.3	4.50±0.04	1.09±0.28
3	18.7±0.0	6.81±0.01	6.29±0.06
4	18.6±0.0	6.45±0.03	3.37±0.15
5	17.6±0.0	6.36±0.02	4.64±0.26

Table 2. Results of nested-ANOVA for the comparison of water conditions in between the sites where water spiders were collected and were not collected.

	d.f.	F-value	P
Temperature (Co)	1,20	10.249	<0.005
pH	1,20	8460.724	<0.001
DO (mg/l)	1,20	568.329	<0.001

water containing less than 3 mg/l of dissolved oxygen (Yamagishi *et al.* 1976). However, the water spider could live in such low DO water as shown in our results, possibly because they did not take oxygen from water. Consequently, the low DO would prevent potential predators, such as fishes, to swim into the habitat of the water spider and would give an enemy free space to the water spiders in Mizoro pond. From the field observation at a hundred of ponds in Aomori prefecture, Katsura & Nishikawa (1981) also suggested that the water spider seemed to live at ponds where no fish were observed. Our results supported their suggestion even in this local scale.

The low pH and low DO are thought to be made by the activity of sphagna and organic acid in the pond. (Kadono 1981). Sphagna also gives the supporting structure of the air dome of the water spider. Consequently, sphagna are thought to be important for making environmental condition of the habitat of the water spider in Mizoro pond.

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摘　要

ミズグモ（*Argyroneta aquatica*）は水中で生活を行う唯一のクモであるが，日本では生息環境の分断化と悪化から限られた水域にしか生息しておらず，早急に保全の対策が必要とされている．ところが，ミズグモの生息環境に関する情報はこれまで報告されていなかった．ミズグモを保全するための研究として，我々は 1996 年の 5 月に京都府深泥池において，ミズグモの生息水域と生息しない水域の水の温度，pH，溶存酸素(DO)を

比較した．その結果，ミズグモの生息する水域はpHとDOが共に低かった．特にDOは魚の生息のできないほどの低い値であり，このことによってミズグモは天敵である魚から逃れることができるとみられる．また，この低pHとDOは深泥池に分布するミズゴケによる環境形成作用によって維持されており，ミズグモの保全にはこのミズゴケ群落を維持することが重要である．

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